

1.
a) $\text{not}(\text{if}(\text{not true})(\text{not true})(\text{not false}))$

$\text{not-T} \frac{\text{true} \Downarrow \text{true}}{\text{not true} \Downarrow \text{false}}$	$\text{not-F} \frac{\text{false} \Downarrow \text{false}}{\text{not false} \Downarrow \text{true}}$
$\text{If-F} \frac{\text{if}(\text{not true})(\text{not true})(\text{not false}) \Downarrow \text{true}}{\text{not}(\text{if}(\text{not true})(\text{not true})(\text{not false})) \Downarrow \text{false}}$	

if not true \rightarrow false
 if (not true)(not true)(not false) \rightarrow if (false (not true)(not false))
 not (if (not true)(not true)(not false)) \rightarrow not (if false (not true)(not false))
 not (if false (not true)(not false)) \rightarrow not (not false)
 not (not false) \rightarrow true
 not (if (not true)(not true)(not false)) \rightarrow *false
 not

not
 if (false (not true)(not true)) \rightarrow not false
 not not false \rightarrow true
 not (not false) \rightarrow not true
 not (not false) \rightarrow *false
 Trans

Retl
 not true \rightarrow false
 false \rightarrow *false
 Trans

9)

c) $\text{not}(\text{if}(\text{not true})(\text{not true})(\text{not false}))$
 $\rightarrow \text{not}(\text{if false}(\text{not true})(\text{not false}))$
 $\rightarrow \text{not}(\text{if false}(\text{not true}) \text{true})$
 $\rightarrow \text{not}(\text{true})$
 $\rightarrow \text{false}$

2.

$$\begin{array}{l}
 \text{not-}\top \frac{e \Downarrow \text{false}}{\text{if-}\top \frac{\text{not } e \Downarrow \text{true} \quad e \Downarrow \text{false}}{\text{if}(\text{not } e) e (\text{not } e) \Downarrow \text{false}}} \\
 \text{not-}\top \frac{\text{if}(\text{not } e) e (\text{not } e) \Downarrow \text{false}}{\text{not}(\text{if}(\text{not } e) e (\text{not } e)) \Downarrow \text{true}}
 \end{array}$$

3.

a)

$$\text{And-}\top \frac{e_1 \Downarrow \text{true} \quad e_2 \Downarrow b}{\text{and } e_1 e_2 \Downarrow b} \quad \text{And-}\top \frac{e_1 \Downarrow \text{True} \quad e_2 \Downarrow b}{\text{and } e_1 e_2 \Downarrow b}$$

b) $\text{and true } e_2 \rightarrow e_2 \quad \text{and false } e_2 \rightarrow \text{false}$

$$\text{And} \frac{e_1 \rightarrow e'_1}{\text{and } e_1 e_2 \rightarrow \text{and } e'_1 e_2}$$